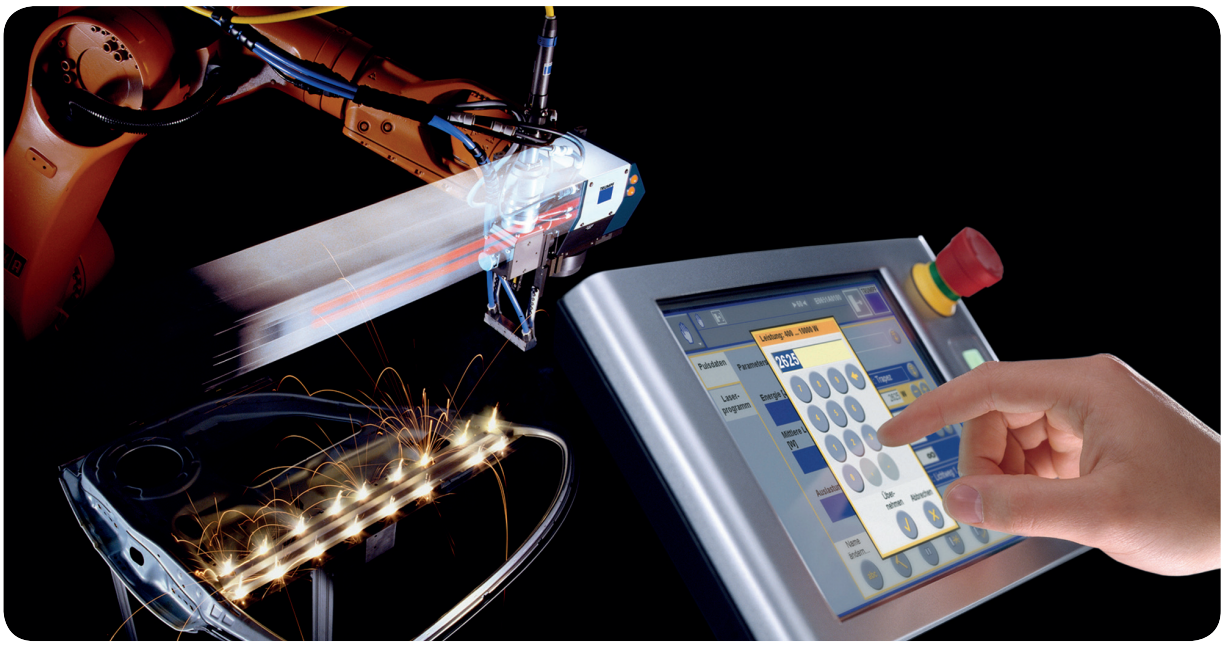
kontron

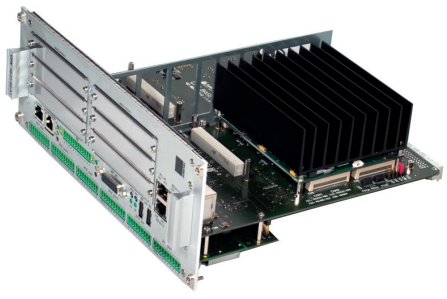
» Application Story «

Customization in Automation



Laser control in semi-custom design

TRUMPF migrates from VME to customized Computer-on-Module design



With the migration from VMEbus to a solution with Computer-on-Modules on tailor made carrier boards, the new laser control from TRUMPF Laser GmbH & Co. KG retains not only such outstanding characteristics as robustness, modularity, and longterm availability; with the individual, ready-toinstall design, a wide range of interfaces was also efficiently implemented in the desired number and type. Trumpf was supported in the migration by Kontron.

Lasers prove their worth in tens of thousands of tough industrial environments. They are contactless in their operation, do not wear out, and are very flexible: The laser beams of solid-state lasers, for example, can be set using a flexible glass fiber from the beam source to the target location (Figure 1). The requirements for the respective laser control are high, for it must not only be flexible in terms of different applications and various connected peripherals. It must also offer high performance and should be characterized by longevity and robustness to survive in the harsh environment of everyday industrial life.

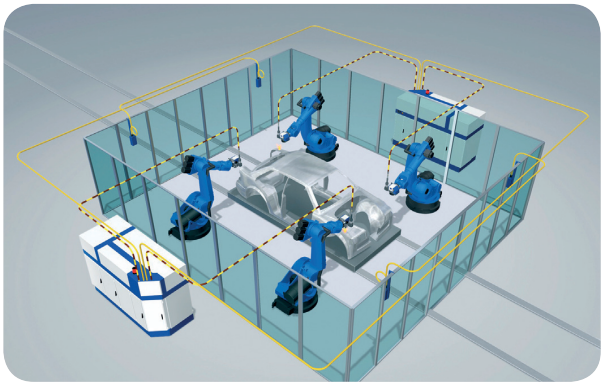


Figure 1: Solid-state laser beams can be coupled into flexible laser light cables through which they are guided to the target location.

20 years ago, TRUMPF Laser GmbH & Co. KG in Schramberg began using a modular VME system for control of their solid-state lasers. The ability of VME to accompany the technical evolution of the laser control for so long was mainly based on the advantages of the VME-based architecture: extremely high ruggedness, long term availability of components, and a long service life even with increasing performance demands and increasing levels of integration. In addition, the VMEbus is technically characterized as an asynchronous architecture that does not slow down when new hardware is mixed with old. When more performance was needed, the CPU module could simply be replaced. This was all offered with system-specific modularity, so that the upgrade could easily be carried out with COTS components. VME was, therefore, a well-rounded solution for long-term product strategy.

The search for a worthy successor

But times and needs change. For an optimal integration of solid-state laser control into production networks with various robots for example, there is still a need for widespread and individualized interfaces, such as Fieldbus or Industrial Ethernet interfaces, for sensor and control circuits. However, many interfaces, which formerly needed to be integrated with various add-on boards (such as real-time Ethernet protocol interfaces via EtherCAT) are now available on the CPU board. As a result, the number of required add-on cards has dwindled. Furthermore, it has become increasingly apparent that most peripherals are connected via USB or Ethernet interfaces, for example, reducing the number of different interfaces. Therefore, for TRUMPF, the high modularity of VME in the control of solid-state lasers was no longer necessary. It was important for TRUMPF, however, to maintain the link to the company's component bus (TRUMPF Peripheral Bus) for signal and data distribution of components such as lasers, safety equipment, and cooling. In the past, TRUMPF used a separate VME board for this purpose. Such coupling cards are no longer necessary due to the advancement of flexibly programmable FPGA chips over the past few years.

Programmable logic replaces dedicated hardware

Today, the implementation of the bus mastering for the component bus is realized by a field programmable gate array (FPGA) that can be accessed by the CPU via PCI. This flexibly-programmable device has the advantage that the control can now communicate directly with the component bus and actuate the various components through transfer protocols with optimal performance. Evolutionary changes in the protocols can simply be implemented by the appropriate programming of the FPGA logic, ensuring the best possible future orientation. Thus, the wish list comprised largely standardized hardware, but with an individually-tailored interface portfolio and a dedicated interface for the component bus.

OSADL-Linux support

Since the change of its operating system from OS/9 to Linux, TRUMPF wanted the best possible Linux support, particularly due to its involvement in the industry-driven real-time operating system OSADL. Because the hardware supports the operation of OSADL Linux, it is able to reap the benefits of a broad developer and tool base: shorter development times, an optimal, well-established integration of graphical user interfaces, and, therefore, an improved time-to-market. For TRUMPF this had the advantage of allowing the software development department to focus on porting from OS/9 to Linux and on the integration of the human-machine interfaces (HMI) while sparing it the time-consuming process of adapting the OSADL operating system to the embedded hardware platform.

Finding the optimal solution with expert help

To find the optimal hardware platform for this list of requirements and to avoid pitfalls, TRUMPF consulted extensively with experts from the real-time Linux and embedded hardware fields. It was necessary to ensure an optimal combination of software and hardware and to find a scalable long term solution that preserved the benefits of the incumbent VME

Technology. Furthermore, the hardware platform should offer the advantages of modern computer technology, such as the cost-effective and comprehensive integration of current and application-specific interfaces. In addition to the FPGA, these should include digital inputs and outputs for applications, lasers, switching stations, external clock signal generators, stepper motors, etc., that are addressed directly via digital connections. With these customization requirements, TRUMPF then had the following options to choose from: the use of motherboards or Single Board Computers (SBC) with PCI or PC/104 extension cards for the FPGA and digital I/Os, a CompactPCI design similar to VME, or an individual board-level solution based on Computer-on-Modules. The optimal solution for TRUMPF ultimately crystallized in a semi-custom design with a highly integrated Computer-on-Module on an individual carrier board. Furthermore, the custom front panel design allows the systems to be removed with similar ease to systems with a passive backplane.

Individual carrier board design

There were several reasons for TRUMPF's decision to use a semi-custom design. It has the benefits of a fully-custom solution but with a faster time to market. The individually designed carrier boards allow all interfaces, including Ethernet, Digital I/O, and FPGA coupling to be implemented exactly in the desired number, specification, and arrangement of front and rear housing - a convincing argument against a solution with a standard SBC or motherboard. Moreover, due to the number of units required, TRUMPF was able to obtain this custom-made solution for the price of an "off the shelf" system without sacrificing the proven benefits of the VMEbus. The semi-custom design also provides the desired long-term availability for industrial use, necessary ruggedness, and, due to its modular design, guarantees future security. Thanks to the modular integrated Computer-on-Modules, the control can grow with future requirements and innovations by replacing the module, for example, with a module with greater processing power.

Nearly 100% system availability

The high system availability (nearly 100%) of the new TRUMPF laser systems is obtained through the optimal combination of hardware and software, and also the built-in remote administration via a VPN connection (or alternatively, via the modular built-in modem) by the BSI-certified TRUMPF TelePresence portal. Through the secure remote connection, TRUMPF engineers can perform nearly the same system diagnostics and integration support tasks as if they were on site.

Should the operating system or the built-in flash memory cause problems, the system also provides a rescue Linux located directly in the BIOS module. The rescue system automatically starts when the integrated flash memory card fails. When needed, it can also be started manually via the front panel of the system. Thus, it offers an additional, higher service instance to which, for example, hardware diagnostics and repairs - also via remote connection to the TelePresence Portal - are made possible. Here again, the design with Computer-on-Modules proves to be more space-saving and cost-effective than a corresponding VME solution which would require additional communication and diagnostic modules for a similar range of services.

On the safe side in the long term

Kontron's design specialists in Kaufbeuren not only carried out the consulting and design of the system, but also handled its serial production. "In order to keep the embedded hardware on the safe side in the long term, a supplier to be considered as a qualified partner for TRUMPF must not only prove control over the technology but also over the logistics", says Rainer Thieringer, head of software development at TRUMPF. Kontron not only guarantees availability of spare parts up to 10 years, but the embedded hardware specialist has, in recent years, already successfully implemented and mass produced numerous similar layouts. Kontron was the ideal partner for the evolutionary migration from VME to the new semi-custom design based on Computer-on-Modules; they provided a compact and affordable solution that is, at the same time, state-of-the-art. Kontron's commitment to Linux also benefits TRUMPF. For example, Kontron offers its own Embedded Linux distribution, which was created exclusively through the use of open source modules, and a license may be obtained free of charge for supported hardware. It is based on the real-time OSADL Linux kernel and includes a Linux file system, a cross compiler toolchain, a board driver, libraries for the Kontron-specific hardware features as well as other tools to download, and an extensive user manual. The extensive board support packages that Kontron provides also unburden the development departments of clients like TRUMPF.

Conclusion

The change of an embedded system platform often also means a change of suppliers. However, since Kontron boasts the world's most comprehensive standard product portfolio and also ensures the highest quality standards even with individual design services, the migration from one platformto another is possible at any time. The value of this is, first, that sales and development are not afraid to take alternative designs into consideration to find the best possible approach for each requirement. On the other hand, standardized enterprise building blocks simplify migration paths for customers. Finally, the growing know-how between the customer and supplier is not lost. All these factors amount to real long-term availability beyond the application duration, and maximum efficiency in the use of appropriate embedded computer technology.

Figure 2: The new control is used in the TRUMPF TruDisk 1000 disk laser, for example.

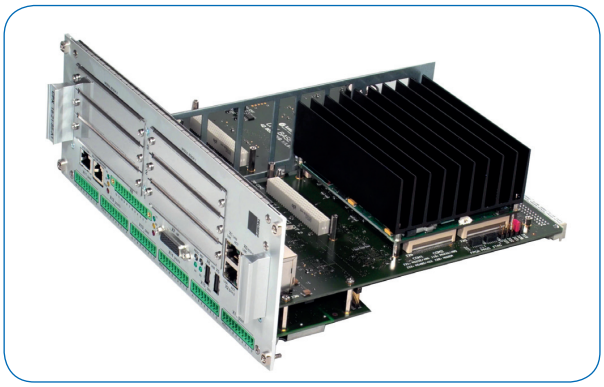


Figure 3: The semi-custom design with a passively-cooled Computer-on-Module is also tidy on the inside

The ready-to-install laser control in detail

» Coupling to the customized bus is efficient and future-proof due to the integrated programmable FPGA controller.

» Four real-time Ethernet connections are available for Ethernet-based fieldbus systems and thus are useful for a growing range of external peripherals.

» 24 digital inputs and outputs are available for applications in which lasers, shared switches, external clock signals, conventional stepper motors, etc. should be addressed directly via digital connections.

» The secure connection to the TRUMPF TelePresence Portal for remote management is available via the modular modem and through a VPN connection via Ethernet.

» The remote display (8.4", 800x600 pixels) can be placed precisely wherever it is needed: for operation, programming, diagnostics, configuration, and data recording.

» The OSADL consortium's real-time Linux operating system is well suited for the high performance requirements of the laser pulse functions and application development for the open source system is quick and easy.

» The in-BIOS Rescue Linux provides additional control against failures and also allows remote diagnostic and management procedures.

» The control is extensible for, e.g., Bluetooth or WLAN functionality through the miniPCI slot.

Figure 4: The TRUMPF laser control in Kontron's ready-to-install semi-custom design.

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Über TRUMPF

TRUMPF ist im Bereich industrieller Laser und Lasersysteme Technologie- und Weltmarktführer. Der Rundum-Service des Unternehmens reicht von Machbarkeitsstudien in weltweit eingerichteten Applikationslabors, über die Beratung zur lasergerechten Konstruktion, bis hin zur vollständigen Anlagenkonzeption.

About Kontron

Kontron is a global leader in embedded computing technology. With more than 40% of its employees in research and development, Kontron creates many of the standards that drive the world's embedded computing platforms. Kontron's product longevity, local engineering and support, and value-added services, helps create a sustainable and viable embedded solution for OEMs and system integrators.

Kontron works closely with its customers on their embedded application-ready platforms and custom solutions, enabling them to focus on their core competencies. The result is an accelerated time-to-market, reduced total-cost-of-ownership and an improved overall application with leading-edge, highly-reliable embedded technology.

Kontron is listed on the German TecDAX stock exchanges under the symbol "KBC". For more information, please visit: **www.kontron.com**

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